PROPOSED DRAFT

TOTAL MAXIMUM DAILY LOAD (TMDL)

for

Fecal Coliform

in

Bayou de Chien, Central Creek, and Cooley Creek

(Hydrologic Unit Code 08010201)

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EPA United States Environmental Protection Agency

Kentucky UNBRIDLED SPIRIT

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This report has been approved for release:

David W. Morgan, Director

Division of Water

5/19/06

Date

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LIST OF ABBREVIATIONS

BMP	Best Management Practices
BPJ	Best Professional Judgment
CFS	Cubic Feet per Second
DEM	Digital Elevation Model
DMR	Discharge Monitoring Report
EPA	Environmental Protection Agency
GIS	Geographic Information System
HUC	Hydrologic Unit Code
KDFWR	Kentucky Department Fish & Wildlife Resources
KDOW	Kentucky Division of Water
KPDES	Kentucky Pollutant Discharge Elimination System
LA	Load Allocation
MGD	Million Gallons per Day
MOS	Margin of Safety
MS4	Municipal Separate Storm Sewer Systems
NASS	National Agriculture Statistics Service
NCDC	National Climatic Data Center
NLCD	National Land Cover Data
NOAA	National Oceanic & Atmospheric Administration
NRCS	Natural Resources Conservation Service
PADD	Purchase Area Development District
RM	River Mile
STORET	STORage RETrieval database
TMDL	Total Maximum Daily Load
USDA	United States Department of Agriculture
USGS	United States Geological Survey
WLA	Waste Load Allocation
WWTF	Wastewater Treatment Facility

SUMMARY SHEET
Total Maximum Daily Load (TMDL)

1. 303(d) Listed Waterbody Information
State: Kentucky
Major River Basin: Mississippi River
Pollutant of Concern: Pathogens
Impaired Use: Primary Contact Recreation

Impaired Waterbodies for TMDLs (2004 303(d) List):

Waterbody Name	Segment Length (miles)	County	Suspected Source
Bayou de Chien (from RM 14.0 to 25.9)	11.9	Graves/Hickman	Agriculture
Central Creek (from RM 0.8 to 2.5)	1.7	Carlisle	Unknown
Cooley Creek (from RM 0.7 to 2.3)	1.6	Graves	Minor Industrial Point Sources

Note: Suspected sources as identified in the 2004 303(d) Report for Kentucky.

2. TMDL Endpoints (i.e., Water Quality Standard): 400 colonies/100ml

3. Fecal Coliform Allocation:

Stream	WLA (colonies/day)	LA	Margin of Safety	TMDL	Percent Reduction[3]
Bayou de Chien	0.0 colonies/day[1]	2.49×10^{11} colonies/day	2.77×10^{10} colonies/day	2.77×10^{11} colonies/day	71%
Central Creek	0.0 colonies/day[1]	98.6%	See note 4	98.6%	98.6%
Cooley Creek	2.59×10^{10} colonies/day[2]	99.7%	See note 4	99.7%	99.7%

Notes:
1. New discharges of pathogens will be allowed in the watershed contingent upon an end-of-pipe fecal coliform permit limit of 200 colonies/100ml for a monthly geometric mean and 400 colonies/100ml for a daily maximum value during the recreation season of May 1 - October 31.
2. WLA value based on design flow and acute permit limits and represents the maximum one-day load the facility can discharge. The average monthly load based on design flow and chronic permit limits can not exceed 1.30×10^{10} colonies/day.
3. Overall reduction to achieve the target of 360 colonies/100ml.

4. MOS is both implicit and explicit.

4. Endangered Species (yes or blank):

5. EPA Lead on TMDL (EPA or blank): EPA

6. TMDL Considers Point Source, Nonpoint Source, or both: Both

7. NPDES Discharges to surface waters addressed in TMDLs:

Facility Name	NPDES No.	Design Flow (MGD)	Facility Type	Impacted Stream	Permit Limits	
					Monthly	Maximum
Pilgrim Pride	KY0093874	1.71	Poultry Slaughtering and Processing	Cooley Creek	200 colonies/ 100ml	400 colonies/ 100ml

FECAL COLIFORM TOTAL MAXIMUM DAILY LOAD (TMDL)
BAYOU DE CHIEN, CENTRAL CREEK, AND COOLEY CREEK

1. INTRODUCTION

Section 303(d) of the Clean Water Act requires each state to list those waters within its boundaries for which technology based effluent limitations are not stringent enough to protect any water quality standard applicable to such waters. Listed waters are prioritized with respect to designated use classifications and the severity of pollution. In accordance with this prioritization, states are required to develop Total Maximum Daily Loads (TMDLs) for those water bodies that are not meeting water quality standards. The TMDL process establishes the allowable loadings of pollutants or other quantifiable parameters for a waterbody based on the relationship between pollution sources and in-stream water quality conditions, so that states can establish water quality based controls to reduce pollution from both point and nonpoint sources and restore and maintain the quality of their water resources (USEPA, 1991).

The State of Kentucky has adopted the use of the Watershed Management Framework as a comprehensive means of assessment monitoring to determine use support, assessments, TMDL development, and remediation through the establishment of basin teams. The initial 5-year watershed cycle began in 1997 and focused on assessment monitoring. The concept is to increase the extent of water quality assessment throughout the state. Monitoring in the Tennessee/Mississippi/Cumberland River Unit was conducted between April 2000 and March 2001 and included sampling Bayou de Chien, Central Creek, and Cooley Creek. These waterbodies are located in western Kentucky in the counties of Graves, Hickman, and Carlisle as shown in Figure 1. Detailed location maps of the impaired creeks are provided in Appendix A.

2. PROBLEM DEFINITION

Kentucky Division of Water (KDOW) identified Bayou de Chien, Central Creek, and Cooley Creek as 1st Priority waters on the 2004 303(d) list. Stream segments identified as being in nonsupport of one or more designated uses are classified as 1st Priority. KDOW classifies Bayou de Chien, Central Creek, and Cooley Creek as Recreational Waters and are determined as not supporting the designated use of Primary Contact Recreation (KNREPC, 2003). The three stream segments are impacted by pathogens, which is the result of both point and nonpoint sources. Fecal coliform bacteria are used as an indicator of the presence of pathogens. Of the three stream segments addressed in this report, only Cooley Creek has a permitted facility discharging directly into the impaired segment.

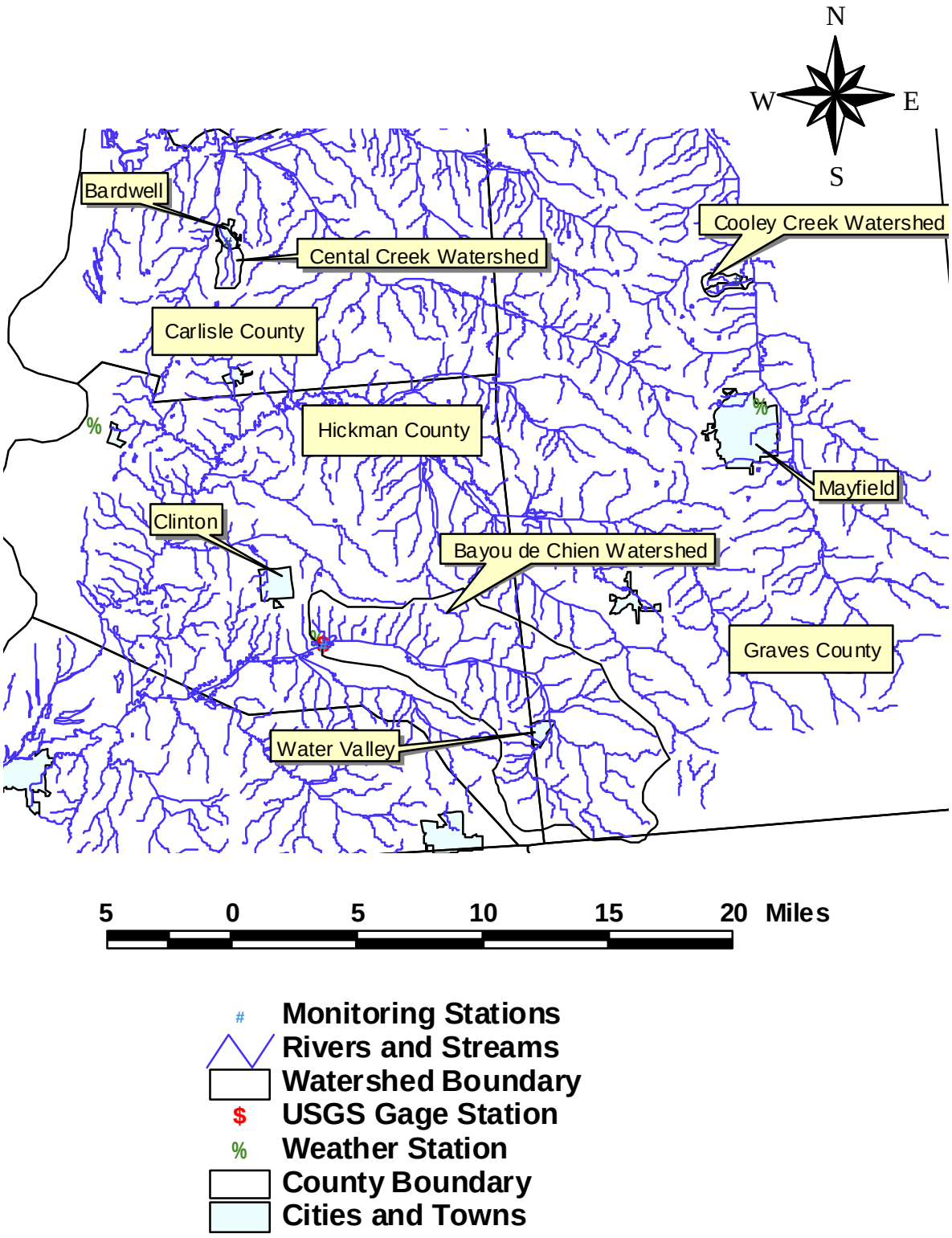

Figure 1. Location of Impaired Streams in HUC 08010201

3. WATERSHED DESCRIPTION

Bayou de Chien

Bayou de Chien is located in southwest Graves County and southeast Hickman County and discharges directly into the Mississippi River. The impaired segment is 11.9 miles extending from River Mile (RM) 14.0 to 25.9 (see Figure 1). The drainage area of the impaired segment is about 68 square miles and includes the City of Water Valley. Land use in this area is predominately agriculture (60%) followed by forest (28%) (See Table 1).

Central Creek

Central Creek is located in central Carlisle County near the City of Bardwell. The impaired segment is 1.7 miles extending from RM 0.8 to 2.5. Central Creek flows into Truman Creek, a tributary of Mayfield Creek, which discharges into the Mississippi River at the Ballard/Carlisle county lines. Land cover in Central Creek watershed is predominately agriculture (43%) followed by forest (34%). Urban area accounts for about 10 percent of the land cover in the watershed (See Table 1).

Cooley Creek

Cooley Creek is located in Graves County near the City of Hickory. The impaired segment is 1.6 miles and extends from RM 0.7 to 2.3. Cooley Creek is a tributary to Mayfield Creek. Land cover in Cooley Creek watershed is predominately agriculture (62%) and forest (22%). Urban landuse accounts for about 14% of the watershed (See Table 1). Conagra Poultry Company of Kentucky operates Pilgrim Pride, a poultry slaughtering and processing facility (KY0093874) located in the Cooley Creek watershed. The facility is permitted to discharge 1.71 MGD of processed wastewater, non-contact cooling water and stormwater runoff into Cooley Creek at RM 1.1.

Table 1. Land Cover Distribution[1] (Acres)

Land Use Category	Bayou de Chien		Central Creek		Cooley Creek	
	Area	%	Area	%	Area	%
Urban (pervious)	2383.4	5.2	135.7	10.4	106.1	13.8
Urban (impervious)	8.7	0	10.4	9.1	3.7	0.9
Barren	4.2	0	0	0	0	0
Forest	12,252.5	28.1	447.7	34.3	166.8	21.7
Grassland	348.1	0.8	2	0.2	0	0
Pasture/Hay	8319.6	19.1	206.8	15.8	81.4	10.6
Cropland	18,008.8	41.3	481.5	36.9	397.0	51.7
Open Water	91.2	0.2	4.5	0.3	9.1	1.2
Wetlands	2503.1	5.7	20.2	1.6	0.9	0.1
Total Area (acres)	43,567.3	100	1305.5	100	767.9	100

1. Acreage represents the land use distribution in the watershed of the impaired segment.
2. Data source is National Land Cover Data (NLCD) of 2001 (USGS, 2005b).
3. Urban impervious lands includes NLCD class 23, high intensity developed land,

where impervious surfaces account for 80 to 100% of the total area.

4. WATER QUALITY STANDARD AND TARGET IDENTIFICATION

The impaired waterbodies are classified as Recreation Waters with a designated use of primary and secondary contact (i.e., swimming). The waterbodies addressed in this report are listed as non-support for Primary Contact Recreation (PCR). Fecal coliform and Escherichia coli criteria for PCR are expressed as both acute and chronic concentrations and are applicable during the recreation season of May 1 through October 31. The chronic criteria for fecal coliform content or Escherichia coli shall not exceed 200 colonies per 100 ml or 130 colonies per 100 ml, respectively, as a geometric mean based on not less than five samples collected during a 30-day period. The acute criteria requires the fecal coliform content shall not exceed 400 colonies per 100 ml in 20 percent or more of all samples collected during a 30-day period or 240 colonies per 100 ml for Escherichia coli.

Sample results are compared to the fecal coliform one-day maximum concentration of 400 colonies/100ml, as less than 5 samples were collected in a 30-day period to evaluate the geometric mean. This criterion allows 20 percent of the samples to exceed the maximum concentration but because one sample was collected during any 30-day period sample results were compared to the maximum value. The one-day maximum criterion is reduced 10 percent and this concentration of 360 colonies/100ml (i.e., 400 – 40 = 360) is the target for the TMDLs. By protecting the acute criterion (i.e., one-day maximum) bacteria concentrations in the stream should meet the chronic criterion. The TMDLs are not expressed in terms of Escherichia coli as none of the samples were analyzed for this parameter.

5. WATER QUALITY ASSESSMENT AND DEVIATION FROM TARGET

KDOW maintains ambient monitoring stations throughout the basin. Ambient monitoring on Bayou de Chien is available from 1984 through 1998, but for Central and Cooley creeks pathogen data was collected only in 2000. Pathogen data collected during the recreation season (i.e., May through October) at monitoring stations located within the listed segments are used in the TMDL analysis. Due to the age of data collected in Bayou de Chien, only data collected since 1990 are used in the TMDL analysis. Table 2 provides a list of the monitoring stations used in the TMDL analysis. Table 3 provides a statistical summary of pathogen data collected during the recreation season and includes the percent of samples that deviate from the fecal coliform criterion. Data used to develop the TMDLs are included in appendix B.

Several of the samples collected have laboratory codes of L or K, indicating the sample was off-scale high or low, respectively. The actual value of these samples is not known, but known to be greater than (for those with the L code) or less than (for those with the K code) the value shown. Samples having these laboratory codes were used in the TMDL analysis.

Table 2. Monitoring Stations Located on Impaired Segments

Stream	Station ID/Name	Sampling Period used in Analysis
Bayou de Chien	PRI037 / Bayou de Chien near Clinton, KY	5/16/1990 – 10/30/1998
Central Creek	Central Creek at Railroad Street	5/24/2000 – 10/23/2000
Cooley Creek	Cooley Creek at Hickory	5/24/2000 – 10/23/2000

Table 3. Summary of Fecal Coliform Monitoring Data (Recreation Season)

Statistic	Bayou de Chien	Central Creek	Cooley Creek
PCR Criteria (maximum concentration: 400 colonies/100ml)			
Number samples collected	50	4	6
Percent Exceeding Criteria	10%	100%	80%
Minimum Concentration (colonies/100ml)	33	500	10
Maximum Concentration (colonies/100ml)	1700	35,600	157,200
90^{th} Percentile Concentration (colonies/100ml)	400	25,745	100,160

Note:

1. In all the streams, less than 5 samples were collected within a 30-day period to evaluate the geometric mean criterion.

Violations of the fecal coliform criteria often occur in response to rainfall events. The National Oceanic and Atmospheric Administration (NOAA) collect meteorological data at numerous locations in Kentucky. Precipitation data collected at stations near the impaired segments are superimposed on the coliform results to identify conditions when violations are occurring. The correlation between rainfall and coliform concentrations depends on the proximity of the meteorological station to the monitoring station. The NOAA station near Clinton, KY is within 0.5 miles of the monitoring station in Bayou de Chien and a strong correlation between rainfall and runoff should exist. The nearest NOAA weather station to Central Creek is about 10 miles southwest and the station closest to Cooley Creek is about 5 miles south near Mayfield, KY. Figure 2 through Figure 3 show the correlation between fecal coliform measured in the impaired segments and precipitation measured at nearby NOAA stations. The amount of rain falling the day of and the day before sampling is provided in Appendix B. Rainfall amounts occurring on the days fecal coliform violations were measured are shown in Table 4 through Table 5.

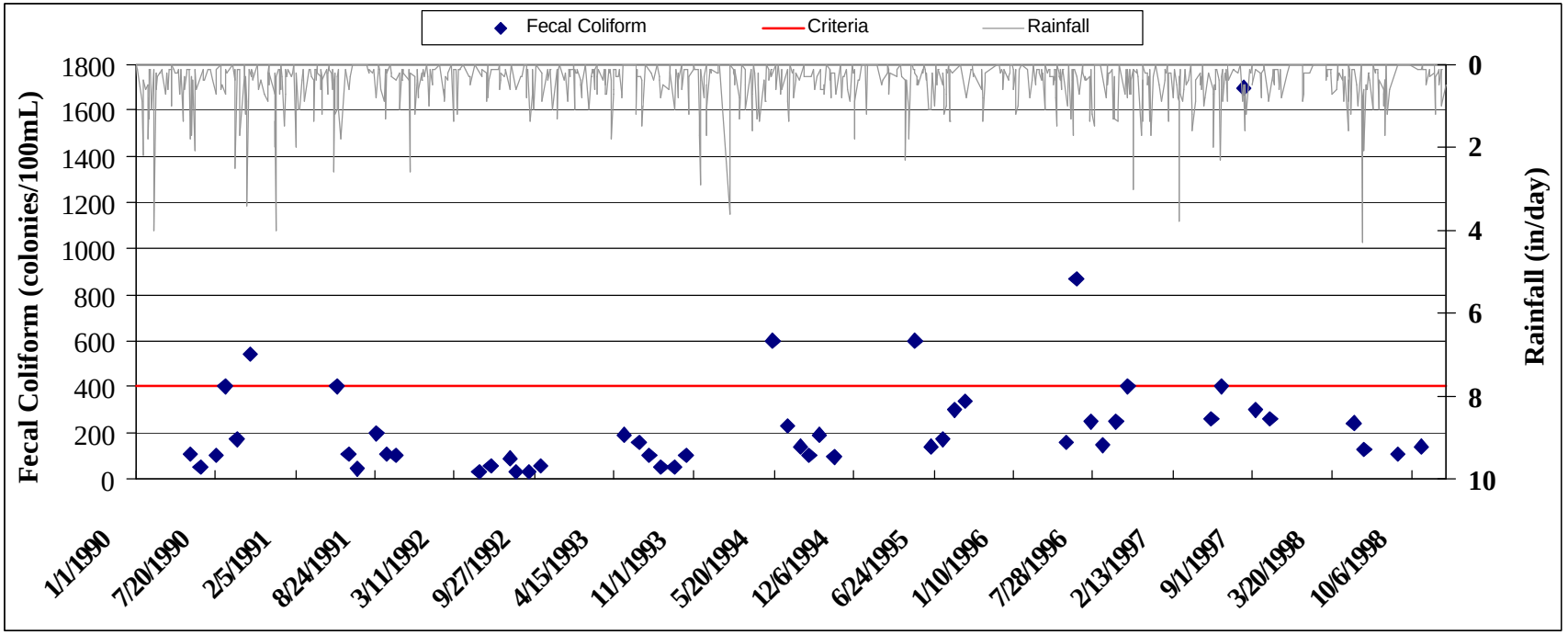

Figure 2. Fecal Coliform Concentration in Bayou de Chien and Rainfall Measured at Clinton, KY (Weather Station ID 151631)

Table 4. Rainfall Measured at Weather Station at Clinton, KY and Fecal Coliform Violations in Bayou de Chien

Sample Date	Concentration	Rainfall day of sampling (in/day)	Rainfall day before sampling (in/day)
10/15/1990	540	0	0
5/16/1994	600	0	0.3
5/9/1995	600	0.2	0.1
6/18/1996	870	0.3	0
8/11/1997	1700	0	0

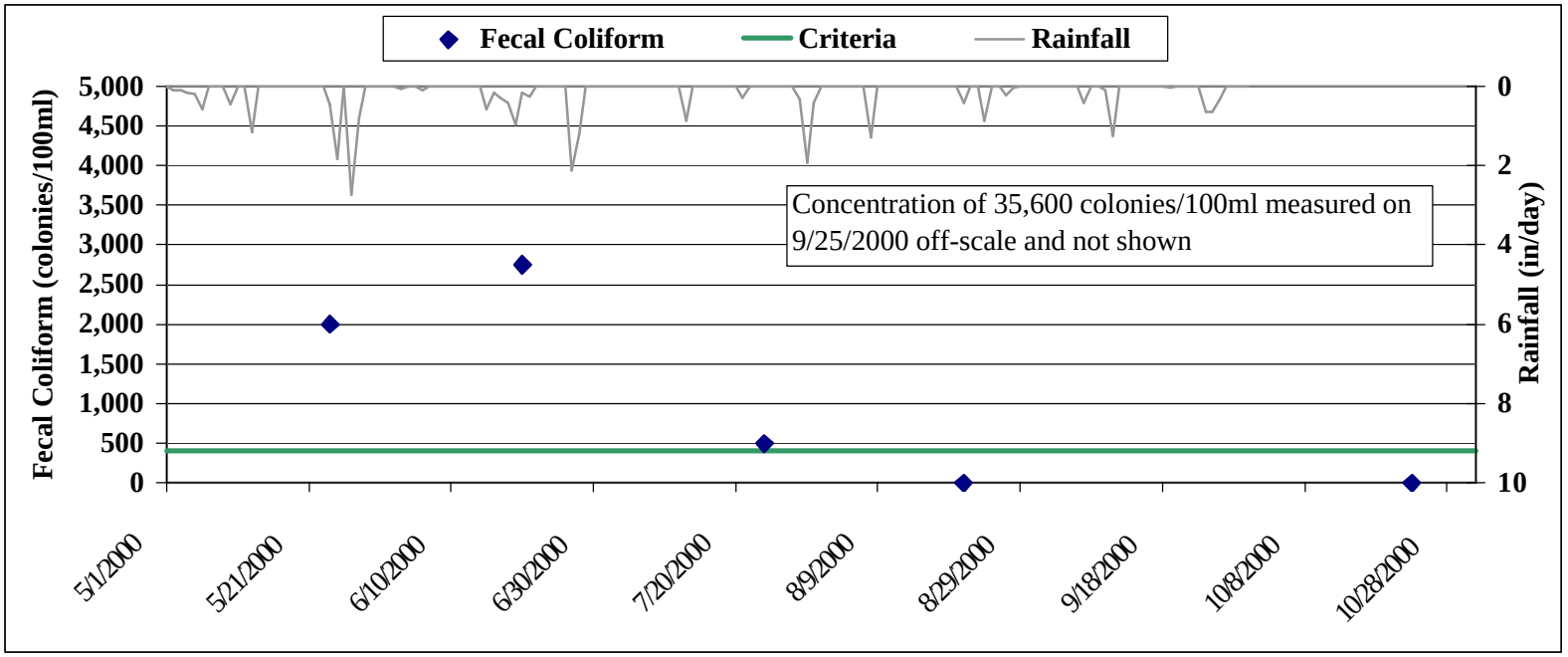

Figure 3. Fecal Coliform Measurements in Central Creek and Rainfall Recorded at Columbus, KY (Weather Station ID 151727)

Table 5. Rainfall Measured at Columbus, KY and Fecal Coliform Violations in Central Creek

Date	Concentration	Rainfall day of sampling (in/day)	Rainfall day before sampling (in/day)
5/24/2000	2000	0.44	0
6/20/2000	2750	0.15	0.98
7/24/2000	500	0	0
9/25/2000	35,600	0	0

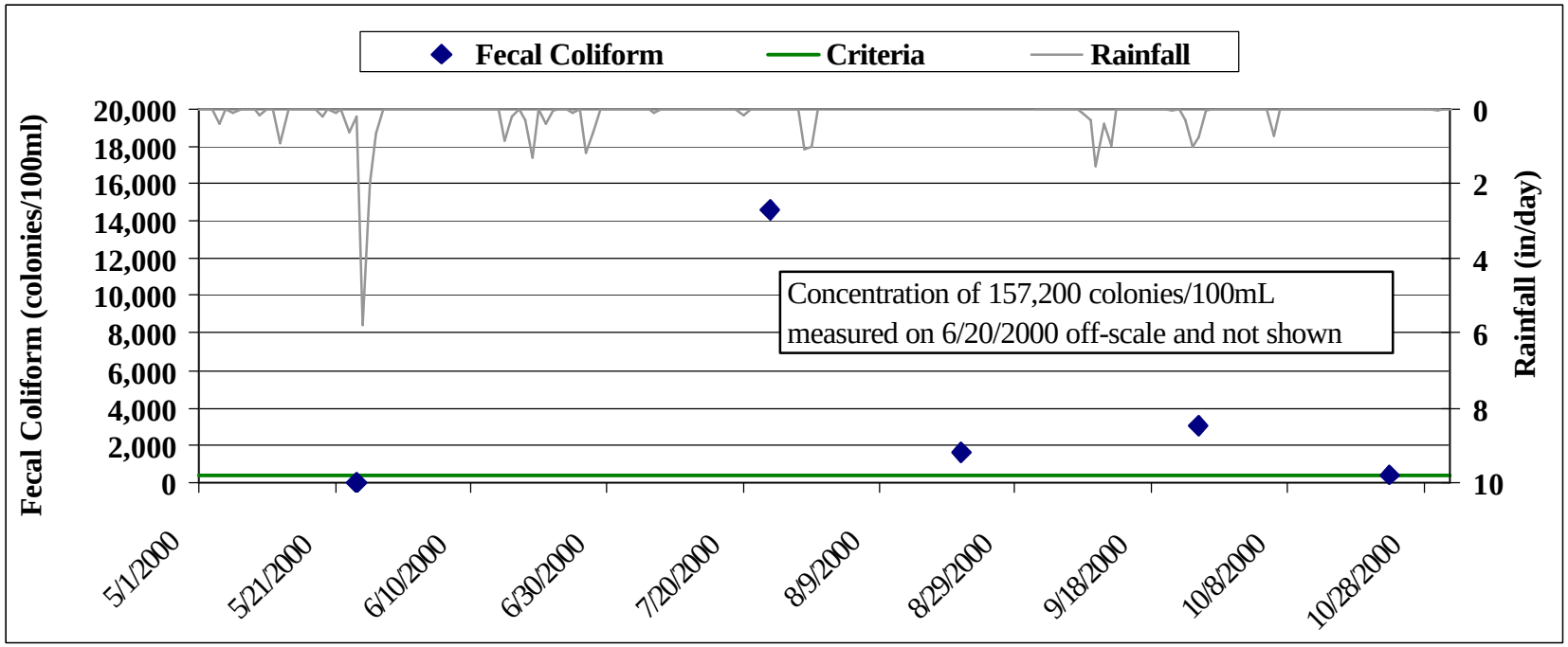

Figure 4. Fecal Coliform Measurements in Cooley Creek and Rainfall Measured at Mayfield, KY (weather station ID 155233)

Table 6. Rainfall Measured at Mayfield, KY and Fecal Coliform Violations in Cooley Creek

Date	Concentration	Rainfall day of sampling (in/day)	Rainfall day before sampling (in/day)
6/20/2000	157,200	0.01	1.3
7/24/2000	14,600	0	0
8/21/2000	1,600	0	0
9/25/2000	3,000	0.77	1

6. SOURCE ASSESSMENT

An important part of the TMDL analysis is the identification of source categories, source subcategories, or individual sources of coliform bacteria in the watershed and the amount of pollutant loading contributed by each of these sources. Sources are broadly classified as either point or nonpoint sources. A point source is defined as a discernable, confined, and discrete conveyance from which pollutants are or may be discharged to surface waters. Point source discharges of industrial wastewater and treated sanitary wastewater must be authorized by the state through the Kentucky Pollutant Discharge Elimination System (KPDES) permit process. KPDES facilities discharging treated sanitary wastewater or stormwater (i.e., Phase I or II MS4 discharges) are considered primary point sources of fecal coliform.

Nonpoint sources of coliform are diffuse sources that cannot be identified as entering a waterbody through a discrete conveyance at a single location. These sources generally, but not always, involve accumulation of bacteria on land surfaces and wash off resulting from storm events. Typical nonpoint sources of coliform include:

- Background (including wildlife)
- Agricultural activities
- Failing Onsite Sewer Treatment and Disposal Systems (septic tanks)
- Untreated sewage which is "straight piped" to the ground or a waterway
- Urban development (outside of Phase I or II MS4 discharges)

6.1 Point Sources

A wasteload allocation (WLA) is given to KPDES facilities discharging to surface waters. Facilities that dispose of wastewater by means other than surface water discharge, such as through spray irrigation or underground injection wells, typically treat wastewater to less stringent secondary standards and are not given a WLA in the TMDL. This TMDL requires all KPDES facilities to be in compliance with permit limits.

Pilgrim's Pride (KY0093874) is a poultry slaughtering and processing facility located in the Cooley Creek watershed. This facility is permitted to discharge 1.71 MGD of treated wastewater at RM 1.1, located upstream of the monitoring station where coliform violations have been measured. The facility fecal coliform permit limits are expressed as a monthly geometric mean of 200 colonies/100ml and a daily maximum value of 400 colonies/100ml. Pilgrim's Pride does not have permit limits for Escherichia coli. This facility also has a water withdrawal permit allowing pumping of 3 million gallons per day (MGD) from wells located adjacent to Cooley Creek. This withdrawal could potentially reduce base flows in Cooley Creek, thereby reducing the potential for dilution of the point source discharge.

A review of discharge monitoring reports (DMR) from the facility indicates exceedances of the daily maximum limit three times in 2000 (see Appendix C). The facility is required to report monthly results and do not indicate the date the violation occurred; therefore, it is not possible to correlate

high coliform concentrations in the effluent with coliform exceedances at the monitoring station. To achieve water quality standards in Cooley Creek, this facility must discharge effluent at concentrations meeting or below permit limits.

Central Creek was the discharge point for the Bardwell Waste Water Treatment Plant (WWTP). The facility ceased operating in January 2000 and wastewater was routed to the Carlisle County Regional Sewer Treatment Plant (KY0102156). Effluent from the Carlisle County facility discharges into Truman Creek downstream of the confluence with Central Creek. Collection lines cross Central Creek at numerous locations and leaking pipes could contribute to impairment, especially during wet weather events. A review of DMR data from the Carlisle County facility indicates the facility exceeded permit limits eight times in 2000 (see Appendix C). This facility exceeded the geometric mean and one-day maximum criteria, an indication of both chronic and acute problems.

The Purchase Public Service Corporation is responsible for maintenance and enhancement of wastewater treatment facilities (WWTF) in the 8-county region, and includes those facilities located in Hickman, Carlisle, and Graves counties. The company uses a video inspection system to aid in identifying existing or potential collection line problems. The urban areas of Bardwell, Hickory and Water Valley are located in the watersheds of Central, Cooley, and Bayou de Chien, respectively. Wastewater infrastructure repairs are proposed for these urban areas. Improvements to the collections systems in these cities should improve water quality conditions in the impaired streams.

Municipal Separate Storm Sewer Systems (MS4s) may also discharge bacteria to waterbodies in response to storm events. Currently, large and medium MS4s, serving populations over 100,000 people, and small MS4s, serving over 50,000 people with a density of 1,000 people per square mile, are required to obtain a NPDES storm water permit. Phase I or II MS4s are not located in the watersheds of the impaired segments.

6.2 Nonpoint Sources

6.2.1 Background

Background sources of fecal coliform include wildlife that deposit bacteria in their feces onto land surfaces where it can be transported during storm events to nearby streams. Bacteria load from wildlife is assumed background, as the contribution from this source is small relative to the load from urban and agricultural areas. Water fowl often frequent stormwater ponds and contributions of fecal coliform could result in in-stream concentrations above criteria. The impaired watersheds are heavily forested and most likely populated with white-tail deer and other wildlife. Deer populations in the counties of the impaired waterbodies are shown in Table 7.

Table 7. Deer Populations (KY Department of Fish & Wildlife Resources, 2006)

County	Number of Deer	Deer Per Square Mile
Graves	8,197	19
Hickman	3,316	20

Carlisle	2,504	37

6.2.2 Agricultural Sources

Animals

Agricultural animals are both a direct and indirect source of fecal coliform loadings to streams. Cattle with access to streams can have a direct impact on water quality when feces are deposited on stream banks or directly in the stream. Cattle often lay in or near the streams in search of shade or water to drink. Animals grazing in pasturelands will often deposit feces on the land and coliform that does not decay will runoff into the streams during wet weather events. Runoff from pastureland is an indirect source of coliform as a rainfall event is required to transport the coliform to the stream.

The USDA National Agricultural Statistics Service (NASS) compiles Census of Agriculture data by county for virtually every facet of U.S. agriculture (USDA, 2002). The "Census of Agriculture Act of 1997" (Title 7, United States Code, Section 2204g) directs the Secretary of Agriculture to conduct a census of agriculture on a 5-year cycle collecting data for the years ending in 2 and 7. Livestock inventory from the 1997 and 2002 Census of Agriculture reports for Carlisle, Hickman and Graves counties are listed in Table 8. As shown in this table, poultry is the predominate livestock and broilers represent the majority of the inventory. With the exception of the poultry facility in the Cooley Creek watershed, Confined Animal Feeding Operations (CAFOs) are not known to operate in the impaired watersheds.

Agronomic

Between 1997 and 2002 NASS reported in increase in the average size of farm in Hickman, Graves, and Carlisle counties. As shown in Table 9, the number of farms and total acreage in farm land increased in all counties with the exception of Hickman County where a slight decrease was reported. In both 1997 and 2002, most farms in the select counties applied commercial fertilizer to cropland, pastureland, and rangeland, as compared to manure.

The Kentucky Agriculture Water Quality Act (KRS 224.71-100 through 224.71-140) was passed by the 1994 General Assembly. The law focuses on the protection of surface water and groundwater resources from agriculture and silviculture activities. The Act creates the Kentucky Agriculture Water Quality Authority (KAWQA), a 15-member peer group made up of farmers and representatives from various agencies and organizations. All farms (AFOs, CAFOs, and other) greater than 10 acres in size are required to adhere to the Best Management Practices (BMPs) specified in the Kentucky Agriculture Water Quality Plan. Specific BMPs have been designed for all operations.

Table 8. Livestock Inventory (source: NASS, 2002)

Livestock	Number of Farms[1]		Inventory	
	1997	2002	1997	2002
Graves County				
Cattle and calves	511	17,898	388	17,092
Beef Cows	404	329	7457	7726
Dairy Cows	25	24	1271	901
Swine	53	19	27,942	17,600
Poultry (broilers sold)	54	67	32,459,914	47,281,584
Sheep and Lamb	17	8	309	95
Goats (milk and/or angora)	1	10	1	145
Horses and Ponies	N/A	N/A	265	1450
Hickman County				
Cattle and calves	108	122	5274	5981
Beef Cows	87	107	2585	3132
Dairy Cows	11	11	767	692
Swine	24	9	10,467	15,848
Poultry (broilers sold)	7	13	2,699,250	6,175,020
Sheep and Lamb	5	12	83	266
Goats (milk and/or angora)	N/A	N/A	7	189
Horses and Ponies	N/A	N/A	61	315
Carlisle County				
Cattle and calves	108	75	5668	3701
Beef Cows	84	71	2575	1743
Dairy Cows	5	5	332	147
Swine	10	2	4843	(D)
Poultry (broilers sold)	24	38	11,947,161	26,439,808
Sheep and Lamb	5	105	7	149
Goats (milk and/or angora)	N/A	N/A	1	(D)
Horses and Ponies	N/A	N/A	34	184

Notes:

1. A farm is defined as any place from which $1,000 or more of agricultural products were produced and sold, or normally would have been sold, during the census year.
2. N/A = not available.
3. Cattle and calves inventory includes inventory other than beef and dairy.
4. (D) = withheld to avoid disclosing data for individual farms.

Table 9. Farm Statistics

Statistic	Graves County		Hickman County		Carlisle County	
	1997	2002	1997	2002	1997	2002
Number of Farms	1602	1712	350	347	374	380
Acreage	257,061	299,620	125,493	125,273	98,060	107,446
Average Size	160	175	359	361	262	283
Acres Treated with commercial fertilizer, lime, & soil conditioners	111,675	134,887	77,399	68,121	53,150	49,270
Acres treated with manure	N/A	10,527	N/A	7,447	N/A	2,124

6.2.3 Onsite Sewerage Treatment and Disposal Systems (Septic Tanks)

Onsite sewage treatment and disposal systems (OSTDS) including septic tanks are commonly used in areas where providing a centralized sewage collection and treatment system is not cost effective or practical. When properly sited, designed, constructed, maintained, and operated, septic systems are an effective means of disposing and treating domestic waste. The effluent from a well-functioning OSTD is comparable to secondarily treated wastewater from a sewage treatment plant. When not functioning properly, they can be a source of nutrient (nitrogen and phosphorus), pathogens, and other pollutants to both ground water and surface water.

Regional Area Development Districts (ADD) provide information on population served by centralized sewer on a county basis (see
Table 10). The centralized sewer systems service less than half of the population, with the greatest number of unserved households utilizing septic or straight pipes for waste disposal. The percentage of failing septic tanks in each county is not known but the Purchase ADD (PADD) records the number of residential homes investigated with failing septic systems. Based on investigations conducted in 2005, the PADD estimated failing septic systems in about 50 homes in Carlisle County; about 50 homes in Hickman County; and about 100 homes in Graves County (PADD, 2005). The location of these homes was not provided.

Table 10. Population Serviced by Public Sewer

County	Population	Population on Public Sewer
Graves	37,028	14,812 (40%)
Hickman	5,262	1,579 (30%)
Carlisle	5,351	2,087 (39%)

6.2.4 Untreated Sewage

Untreated sewage that is "straight piped," or directly discharged to streams or the land surface with no treatment, has a significant impact on water quality. Discussions with the PADD indicated straight pipes are typically connected to washing machines and sinks and are not used to discharge raw sewage (PADD, 2005).

6.2.5 Urban Development

Urban landuse covers about 20 percent of the watershed in Central Creek and slightly less in Cooley Creek and Bayou de Chien (see Table 1). Domestic pets, stormwater runoff and illicit discharges of wastewater are sources of fecal coliform in urban areas.

7. ANALYTICAL APPROACH

The analytical approach used to develop the TMDLs is dependent on the data collected. A load duration curve is used to analyze the coliform data collected on Bayou de Chien. Flow is measured at the time of sampling and is used to estimate the load transported in the stream. The TMDL for Bayou de Chien is expressed as a daily load in units of colonies per day and as a percent reduction necessary to achieve the allowable load.

In Cooley and Central creeks, insufficient data are available to correlate coliform violations with flow. In addition, the number of samples collected is too small to analyze using statistical methods. For Cooley and Central creeks the TMDLs are expressed as percent reductions necessary to achieve the applicable criteria.

7.1 Load Duration Curve Approach

Load duration curves are based on the conservation of mass principle as defined in Equation 1.

Load = Concentration * Flow * Conversion Factor (Equation 1)

Where: Load = colonies/day
Flow = cfs
Concentration = colonies/100ml
Conversion Factor = (28.247 L/cf * 86400 sec/day * 1000mL/L)/100ml

7.1.1 Flow Duration Curve

The first step in developing load duration curves is to create flow duration curves. A flow duration curve displays the cumulative frequency distribution of daily flow data over the period of record. The curve relates flows measured at a monitoring station to a duration interval representing the percent of time flows are equaled or exceeded. A USGS flow gage (07024000) operates on Bayou de

Chien near the ambient monitoring station. Flow records available at this gage are from October 1939 through September 2004. The flows are ranked statistically from low, which are exceeded nearly 100 percent of the time, to high, which are exceeded less than 1 percent of the time. The confidence in the duration curve approach in predicting realistic percent load reductions increases when longer periods of record are used to generate the curves. The long period of record available at the gage provides a strong confidence that the duration curve represents the range of flow expected in the stream. The flow duration curve for Bayou de Chien is shown in Figure 5.

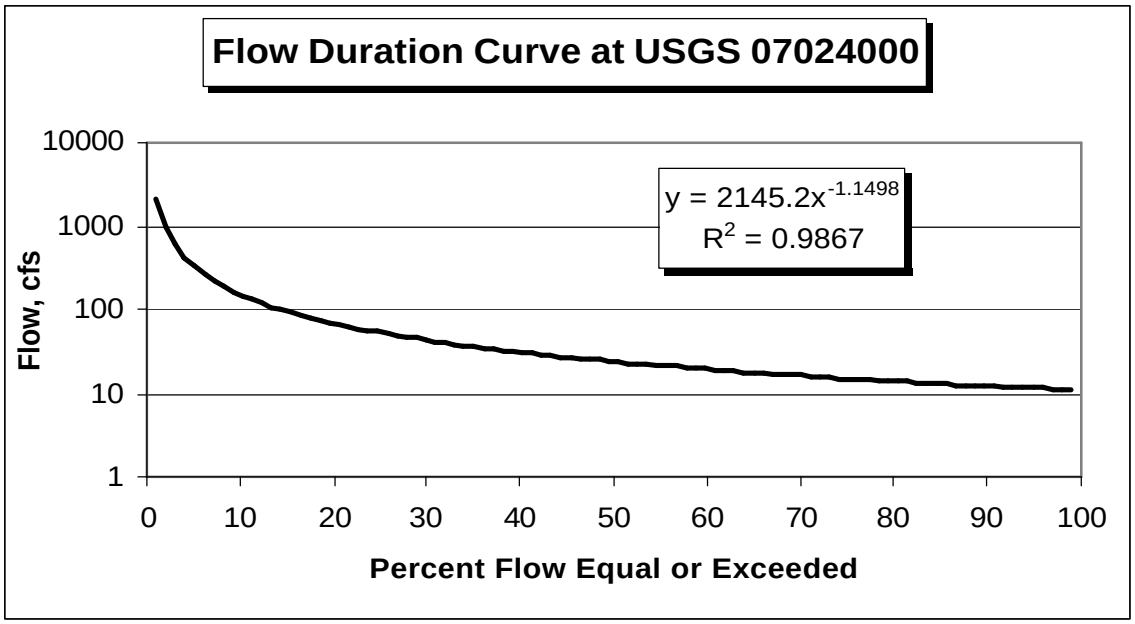

Figure 5. Flow Duration Curve for Bayou de Chien

7.1.2 Load Duration Curve

The load duration curve is a visual display of the existing and allowable loads at each interval on the flow duration curve. The existing loads are based on the in-stream coliform concentrations and flows measured during ambient monitoring. Allowable loads are based on the flow values at each interval on the flow duration curve and the fecal coliform target (i.e., 360 colonies/100ml). Because insufficient data were collected to evaluate the chronic criteria (i.e., 200 colonies/100ml expressed as a 30-day geometric mean) the acute criterion (i.e., not to exceed 400 colonies/100ml in 20 percent of samples) is used to develop the allowable loads.

The fecal coliform results are separated into two groups depending on whether they violate the numerical target (i.e., 360 colonies/100ml). Using Equation 2 (see Section 7.2) loads are calculated for each sample using the flow measured on the sampling day. Loads are expressed in units of colonies per day to reflect the acute criterion. The two groups of loads are plotted on the load duration curve with unique symbols. The positioning of the loads on the curve is based on the duration interval of the stream flow. Loads positioned above the allowable load line represent violations of the target while loads positioned below the line represent compliance with the target.

The load duration curve developed for Bayou de Chien is shown in Figure 6.
The positioning of monitoring data on the load duration curve provides an indication of the potential sources and delivery mechanisms of the pollutant. In general, violations occurring on the right side of the curve typically occur during low flow events and are indicative of continuous pollutant sources, such as NPDES permitted discharges, leaking collection lines, or leaking septic systems. Livestock having access to streams could also be a source during low flow (livestock are not expected to be in the stream during high flows). Violations that occur on the left side of the curve occur during high flow events. Violations in this range are indicative of sources responding to rainfall events. As shown in Figure 6, water quality violations occur during moist conditions (i.e., flows exceeded between 20 and 60 percent of time), often in response to or after rainfall events.

Duration curve intervals can be grouped into broad categories, or zones, in order to provide insight about conditions and patterns associated with the impairment (Cleland, 2003). In these TMDLs, load duration curves are divided into five zones: one representing high flows (0-10%), another for moist conditions (10-40%), one covering median or mid-range flows (40-60%), another for dry conditions (60-90%), and one representing low flows (90-100%). The use of duration curve zones provides a method for communicating technical information in a way that easily conveys conditions associated with problems. Data violations are grouped into zones as shown in Table 11. Within each zone, the existing load shown in this table represents the 90^{th} percentile load of the samples violating the water quality target.

Table 11. Existing Loads by Zones for Bayou de Chien

Concentration (colonies/100ml)	Flow Rank	Flow Zone	Existing Load (colonies/day)	90^{TH} Percentile Load (colonies/day)
600	43.4	mid	4.26×10^{11}	8.17×10^{11}
1700	56.4	mid	9.15×10^{11}	
540	38.6	moist	4.36×10^{11}	9.26×10^{11}
600	31.7	moist	6.02×10^{11}	
870	26.2	moist	1.06×10^{12}	

If a sufficient number of samples plot above the allowable load line (i.e., more than five points), a trendline is drawn through the data violations. In the load curve application, trend lines can be used to predict the load at other duration intervals. The type of line drawn through the data can have several shapes, ranging from linear (simplest form) to moving average. The type of the line chosen should result in a relatively high correlation factor, denoted by the variable R^2. The correlation factor provides an indication of how well the equation of the line represents the data. In general, high correlation factors are not associated with environmental data. A trendline was not drawn through the Bayou de Chien data because of the limited number of samples violating the target concentration.

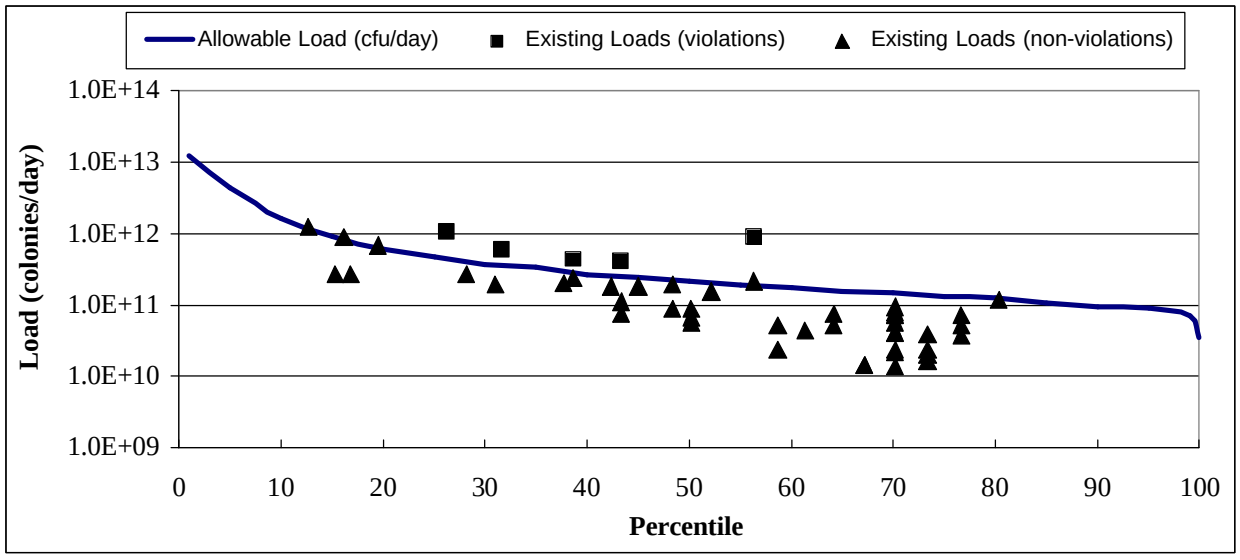

Figure 6. Load Duration Curve for Fecal Coliform in Bayou de Chien

7.1.3 Existing Conditions

In the load duration curve approach, existing loads are expressed as a range based on the zones where the violations occur (See Table 11). When multiple violations occur within a zone, the existing load is represented as 90th percentile value. This approach is considered conservative as existing conditions are based only on violations and does not consider other times when criteria are met.

7.2 Percent Reduction Approach

The "percent reduction" approach was used to express the TMDL for Central and Cooley creeks. The percent reduction required to meet the acute criterion is calculated based on the 90th percentile of coliform concentrations collected during the recreation season that violate the fecal coliform target (i.e., 360 colonies/100ml). The 90th percentile concentration implies 90 percent of the measured exceedances are lower than this concentration or 10 percent are higher.

7.2.1 Existing Conditions

In the percent reduction approach, existing conditions are expressed in terms of concentration violating the target. The 90th percentile concentration of samples violating the target is selected to represent existing conditions. This approach is considered conservative as the water quality standard allows 20 percent of the samples collected in a 30-day period to exceed the maximum concentration of 400 colonies/100ml. In addition, the target concentration represents a 10 percent reduction of the not to exceed criterion. Fecal coliform concentrations measured in Central and Cooley creeks and the calculated 90th percentile concentrations are shown in Table 12.

Table 12. Fecal Coliform Measurements in Central and Cooley Creeks

Date	Concentration (colonies/100ml)	
	Central Creek	Cooley Creek
5/24/2000	2000	<10
6/20/2000	2750	157200
7/24/2000	500	14600
8/21/2000	Dry, no sample	1600
9/25/2000	35600	3000
10/23/2000	Dry, no sample	380
90th Percentile Concentration (based on violations)		
Central Creek	25,745	
Cooley Creek	114,420	

7.2.2 Reductions Required to Meet PCR Criteria

The percent reduction required to meet the fecal coliform criteria is based on the following equation:

Percent Reduction (%) = (existing concentration – target) / existing concentration * 100 (Equation 2)

To reduce the 90th percentile concentration to the target concentration of 360 colonies/100ml, Central Creek requires a 98 percent reduction and Cooley Creek requires a 99 percent reduction. Although these reductions are high, improvements to known sources in the watersheds could result in improved water quality conditions. For example, the KPDES facility discharging to Cooley Creek had several permit violations in 2000 (see Appendix C). The facility reports monthly water quality data and not actual sample dates and results. Although it is not possible to correlate water quality violations in August with reported permit violations at the facility it is likely this facility has a negative impact on water quality in Cooley Creek.

8. DEVELOPMENT OF TOTAL MAXIMUM DAILY LOADS

A TMDL can be expressed as the sum of all point source loads (Waste Load Allocations), nonpoint source loads (Load Allocations), and an appropriate margin of safety (MOS), which takes into account any uncertainty concerning the relationship between effluent limitations and water quality:

$$TMDL = \Sigma WLAs + \Sigma LAs + MOS$$

The objective of a TMDL is to allocate loads among all of the known pollutant sources throughout a watershed so that appropriate control measures can be implemented and water quality standards achieved. 40 CFR §130.2 (i) states that TMDLs can be expressed in terms of mass per time (e.g. pounds per day), toxicity, or other appropriate measure. TMDLs for the impaired waterbodies are expressed in terms of a percent reduction, and where possible, as loads in units of colonies per day. When expressed as a load, the TMDL value represents the maximum one-day load the stream can

transport over a 30-day period and maintain water quality standards.

8.1 Critical Conditions

The critical condition for nonpoint source coliform loadings is typically an extended dry period followed by a rainfall runoff event. During the dry weather period, coliforms build up on the land surface, and are washed off by rainfall. The critical condition for point source loading typically occurs during periods of low stream flow when dilution is minimized. Pathogen data have been collected during both time periods. The critical period for PCR criteria is the recreational season, defined as May through October.

In the load duration method, the critical condition is defined as the zone requiring the largest reduction. Reductions proposed for each zone where violations were observed are shown in Table 13. For Bayou de Chien the critical condition is the mid-flow zone. By achieving the reduction proposed for this zone, water quality standards should be achieved during all other time periods. The selection of the critical period is considered conservative as a smaller reduction is required during other zones when pathogen violations were observed.

Table 13. Load Reductions by Zone for Bayou de Chien

Zone	Existing Load (colonies/day)	Allowable Load[3] (colonies/day)	Reduction (percent)
High (0 – 10%)	N/A	1.10×10^{13}	-
Moist (10 – 40%)	9.26×10^{11}	4.23×10^{11}	56
Mid (40 – 60%)	8.17×10^{11}	2.49×10^{11}	71
Dry (60 – 90%)	N/A	1.66×10^{11}	-
Low (90 – 100%)	N/A	9.40×10^{10}	-

Notes:

1. N/A = not applicable as there were no water quality violations in this zone
2. Loads in each zone represent the 90th percentile load within a given range.
3. Allowable load based on target concentration of 360 colonies/100ml and represents the load allocated to non-point sources.

Critical conditions are accounted for in the analyses by using the entire record of measured flows (when available) and all pathogen data collected during the recreational season. For Central and Cooley creeks, critical conditions are defined as the time period(s) when the highest concentrations were measured in the streams. In Central Creek the highest concentration was measured in September when no rainfall was measured at the weather station, although other violations appear to occur in response to rain events (see Table 5). In Cooley Creek high coliform concentrations were measured in June and appear to occur in response to rainfall events (see Table 6).

8.2 Margin of Safety

There are two methods for incorporating a MOS in the analysis: a) implicitly incorporate the MOS using conservative model assumptions to develop allocations; or b) explicitly specify a portion of the TMDL as the MOS and use the remainder for allocations. An explicit MOS of 10 percent was used in the TMDL analyses. In terms of concentration, the MOS for all TMDLs is 40 colonies/100ml (i.e., 10% of 400 = 40). In the Bayou de Chien TMDL the MOS is calculated based on the 90^{th} percentile flow and MOS concentration (i.e., 40 colonies/100ml). The MOS calculated for each zone in Bayou de Chien is shown in Table 15.

In addition to an explicit MOS, the Central and Cooley creek TMDLs include an implicit MOS through the use of conservative assumptions. In these creeks, existing conditions are based on the 90^{th} percentile concentration which is calculated using only samples exceeding the one-day target of 360 colonies/100ml. This approach is considered conservative as the water quality standard allows 20 percent of the samples collected in a 30-day period to exceed the criterion of 400 colonies/100ml.

8.3 Determination of TMDL, LA and WLA

The TMDL values represent the maximum daily load the stream can assimilate and maintain water quality standards. The TMDLs are based on the one-day maximum fecal coliform concentration as specified in PCR criteria. The TMDL value is reduced by the WLA, if any, to obtain the LA component. TMDL components for the impaired waterbodies as well as the percent reduction required to achieve the target concentration are summarized in Table 14. Calculations of the TMDL components are provided in Appendix B.

Table 14. Summary of TMDL Components

Stream	WLA (colonies/day)	LA	Margin of Safety	TMDL	Percent Reduction[3]
Bayou de Chien	0.0 colonies/day[1]	2.49×10^{11} colonies/day	2.77×10^{10} colonies/day	2.77×10^{11} colonies/day	71%
Central Creek	0.0 colonies/day[1]	98.6%	See note 4	98.6%	98.6%
Cooley Creek	2.59×10^{10} colonies/day[2]	99.7%	See note 4	99.7%	99.7%

Notes:

1. New discharges of pathogens will be allowed in the watershed contingent upon an end-of-pipe fecal coliform permit limit of 200 colonies/100ml for a monthly geometric mean and 400 colonies/100ml for a daily maximum value during the recreation season of May 1 - October 31.
2. WLA value based on design flow and acute permit limits and represents the maximum one-day load the facility can discharge. The average monthly load based on design flow and chronic permit limits can not exceed 1.30×10^{10} colonies/day.
3. Overall reduction to achieve the target of 360 colonies/100ml.
4. MOS is both implicit and explicit.

8.3.1 Waste Load Allocations

The Wasteload Allocation (WLA) for Cooley Creek is expressed as both the maximum one-day load and the average monthly load to reflect both chronic and acute permit limits. The WLA value is calculated using Equation 3.

WLA = Flow (gal/day) × Concentration (colonies/100ml) × 3.785 L/gal × 1000 ml/L (Equation 3)

Using a design flow of 1.71MGD and a daily maximum concentration of 400 colonies/100ml, the WLA is equivalent to 2.59×10^{10} colonies/day. The average monthly WLA is 1.30×10^{10} colonies/day.

Any future facility permitted to discharge bacteria to surface waters in the watersheds of the impaired streams will be required to meet permit limits. Future facilities discharging at concentrations less than permit limits should not cause or contribute to bacteria impairment in the watershed.

8.3.2 Load Allocations

There are two modes of transport for nonpoint source bacteria loading into the stream. First, fecal coliform loading from animals in the stream are considered a direct source of coliform to the stream, as the load is independent of precipitation. The second mode involves coliform loadings resulting from accumulation on land surfaces transported to streams during storm events. Coliforms originating from failing septic systems are transported via groundwater and are considered an indirect loading to the stream.

The positioning of coliform data on the load duration curve provides an indication of the mode of transport occurring during periods of violations. Coliform violations in Bayou de Chien are distributed in the middle to the left side of the curve, indicative of wet weather events. The highest reductions are required in the mid-flow zone. The load in the mid-flow range allocated to nonpoint sources is 2.41×10^{11} colonies/day. A summary of loads assigned to other zones for Bayou de Chien is shown in Table 15.

Table 15. Load Summary by Zone for Bayou de Chien

Zone	Load Allocation (colonies/day)	Margin of Safety (colonies/day)	TMDL (colonies/day)
High (0-10%)	1.10×10^{13}	1.22×10^{12}	1.22×10^{13}
Moist (10-40%)	4.23×10^{11}	4.70×10^{10}	4.70×10^{11}
Mid (40-60%)	2.49×10^{11}	2.77×10^{10}	2.77×10^{11}
Dry (60-90%)	1.66×10^{11}	1.84×10^{10}	1.84×10^{11}
Low (90-100%)	9.40×10^{10}	1.04×10^{10}	1.04×10^{11}

8.4 Seasonal Variation

Seasonal variation was incorporated in the TMDLs by evaluating all pathogen data collected during the recreational season (May through October). Only pathogen data without quality assurance/ quality control (QA/QC) issues were considered in the TMDL.

9. RECOMMENDATIONS

Section 303(e) of the Clean Water Act and 40 CFR Part 130, Section 130.5, require states to have a continuing planning process (CPP) composed of several parts specified in the Act and the regulation. The CPP provides an outline of agency programs and the available authority to address water issues. Under the CPP umbrella, the Watershed Management Branch will provide technical support and leadership with developing and implementing watershed plans to address water quality and quantity problems and threats. Developing watershed plans enables more effective targeting of limited restoration funds and resources, thus improving environmental benefit, protection and recovery.

While the pathogen data set used to develop the TMDL for Bayou de Chien was larger, the data was limited to one monitoring location. Therefore, no specific recommendations for remediation are offered for this watershed until subwatershed monitoring and watershed plan development is conducted. Developing a watershed plan is a critical step for identifying sources, targeting subwatersheds, and identifying the priority remediation efforts in Bayou de Chien.

Watershed management activities are currently underway in a portion of the Bayou de Chien watershed. Through a Clean Water Act Section 319(h) Nonpoint Source Grant, the Jackson Purchase Resource Conservation & Development, Inc. is developing a watershed plan to address water quality impairments and threats in Cane Creek, a tributary to Bayou de Chien. Cane Creek is a 1st Priority 303(d) listed streamd and is also listed as an Outstanding State Resource Water because of known populations of the Relict Darter, an endangered species. Total project funds of $99,780 are being used for subwatershed water quality monitoring, land use assessment, public participation, water quality education and the development and dissemination of a watershed plan for Cane Creek. Subwatershed monitoring in Cane Creek will begin in 2006.

The in-stream pathogen data used to develop the TMDL for Central Creek was limited. Therefore, no specific recommendations for remediation are offered until additional watershed planning is conducted. Development of a watershed plan will provide an integrative approach for identifying and describing how, when, who and what actions should be taken in order to meet water quality standards. This TMDL will provide a foundation for developing a detailed watershed plan.

The city of Bardwell has received a federal State and Tribal Assistance Grant (STAG or SPAP) from EPA of $173,500 to use for rehabilitation of their collection system. The grant application is currently under review and construction should take place in the next one to two years.

The in-stream pathogen data used to develop the TMDL for Cooley Creek was also limited. A review of discharge monitoring reports (DMRs) from the Pilgrim's Pride (KY0093874) poultry

slaughtering and processing facility indicates exceedances of the daily maximum limit three times in 2000 (see Appendix C). To achieve water quality standards in Cooley Creek, the discharge effluent from this facility must meet permit limits. No further recommendations for remediation are offered until detailed watershed planning is conducted. Development of a watershed plan will provide an integrative approach for identifying and describing how, when, who and what actions should be taken in order to meet water quality standards. This TMDL will provide a foundation for developing a detailed watershed plan.

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APPENDIX A LOCATION MAPS

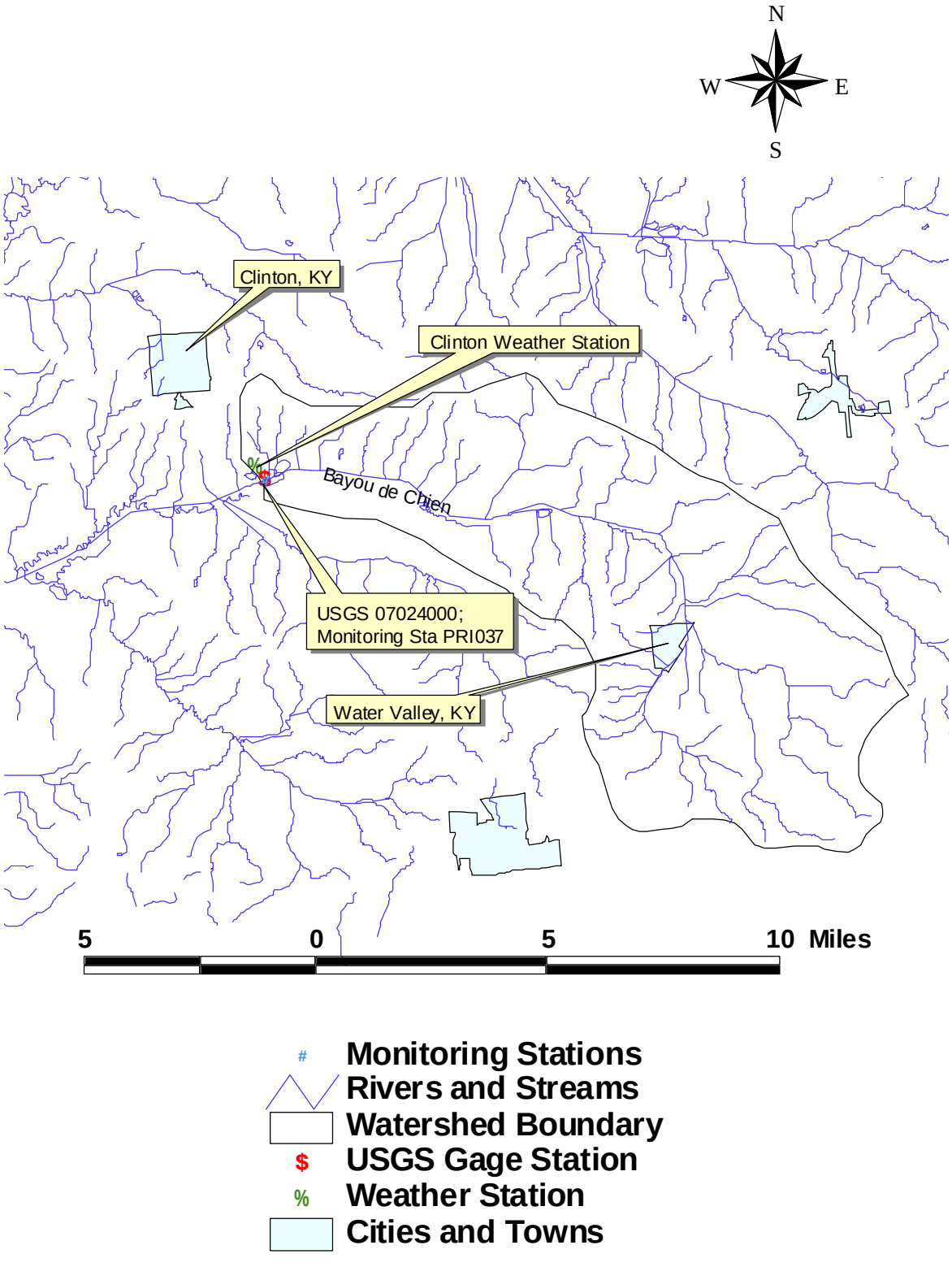

Figure A- 1. Bayou de Chien Location Map

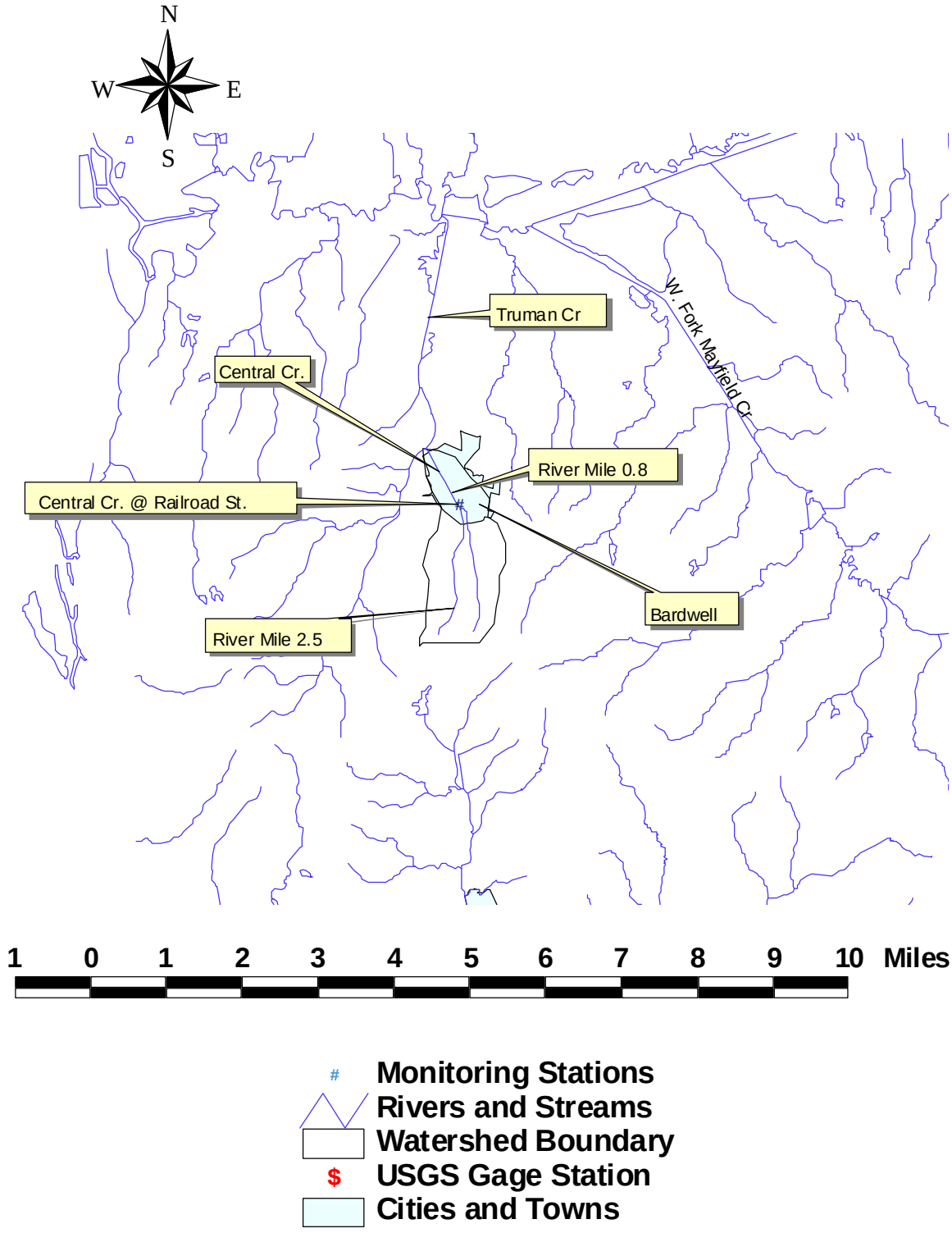

Figure A- 2. Central Creek Location Map

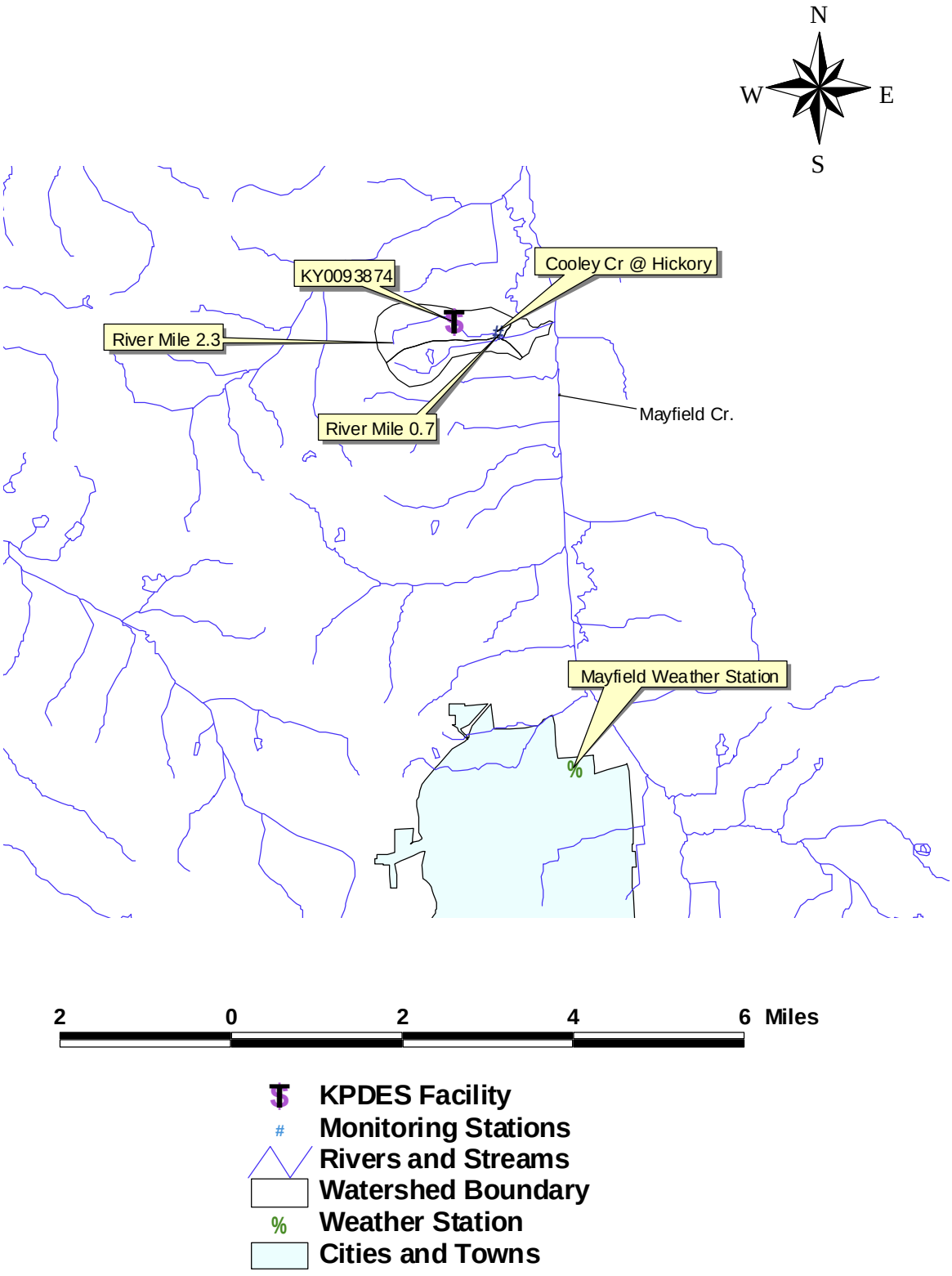

Figure A- 3. Cooley Creek Location Map

APPENDIX B PATHOGEN DATA and TMDL CALCULATIONS

Remark Code	Definition	Use in TMDL
K	Off-scale low. Actual value not known, but known to be less than value shown	Data included in analysis as reported
L	Off-scale high. Actual value not known, but known to be greater than value shown	Data included in analysis as reported

Table B- 1. Remark Codes

Table B- 2. Fecal Coliform Measured in Bayou de Chien During Recreational Season

Date	Concentration (colonies/100ml)	Rcode	Rainfall (in/day)	
			Day of sampling	Day before sampling
5/16/1990	110		1.8	0.1
6/11/1990	53		0	0
7/24/1990	100		0	0.1
8/13/1990	400		0.1	0.7
9/11/1990	170	L	0	2.5
10/15/1990	**540**		0	0
5/20/1991	400		0.3	1.1
6/19/1991	110	L	0	0
7/10/1991	43		0	0
8/27/1991	200		0	0
9/24/1991	110	L	0.2	0.1
10/16/1991	100		0	0
5/11/1992	33	K	0	0
6/9/1992	58	K	0	0
7/28/1992	90		0	0.3
8/12/1992	33		0	0
9/15/1992	33	K	0	0
10/12/1992	60		0	0
5/11/1993	190		0	0
6/16/1993	160		0	0
7/12/1993	100		0	0
8/10/1993	53		0	0
9/14/1993	48		1.1	0
10/13/1993	100		0	0
5/16/1994	**600**		0	0.3
6/21/1994	230		0.1	0

Date	Concentration (colonies/100ml)	Rcode	Rainfall (in/day)	
			Day of sampling	Day before sampling
7/26/1994	140		0	0
8/16/1994	100		0	0
9/13/1994	190		0	0
10/17/1994	93		0	0
5/9/1995	**600**		0.2	0.1
6/19/1995	140		0	0
7/18/1995	170		0.2	0.5
8/15/1995	300		0	0
9/12/1995	340		0	0
5/22/1996	160		0	0
6/18/1996	**870**		0.3	0
7/22/1996	250		0	0
8/21/1996	150		0	0
9/24/1996	250		0	0
10/23/1996	400		0	0.8
5/21/1997	260	L	0	0
6/17/1997	400		0.3	0.6
8/11/1997	**1700**	K	0	0
9/10/1997	300		0	0
10/15/1997	260	L	0	0
5/12/1998	240		0.1	0
6/8/1998	130		0.6	0
8/30/1998	110		0	0
10/30/1998	140		0.1	0

Table B- 3. Target Loads in Bayou de Chien

Percent Rank	Flow (cfs)	Load (colonies/day)	Zone
1	1432.1	1.26E+13	High flow conditions
5	491.05	4.33E+12	
10	185	1.63E+12	
15	100	8.81E+11	Moist conditions
20	68	5.99E+11	
25	52	4.58E+11	
30	43	3.79E+11	
35	37	3.26E+11	
40	31	2.73E+11	
45	27	2.38E+11	Mid-flow conditions
50	25	2.20E+11	
55	22	1.94E+11	
60	20	1.76E+11	
65	18	1.59E+11	Dry conditions
70	17	1.50E+11	
75	15	1.32E+11	
80	14	1.23E+11	
85	12	1.06E+11	
90	11	9.69E+10	
95	9.9	8.72E+10	Low flow conditions
99	8.1	7.13E+10	
100	4	3.52E+10	

Note:

1. Percent Rank is the percent of time flow was equal or exceeded this value. For example, high flows of 185 cfs occur 10 percent of the time. Flows higher than this value occur less than 10% of the time.
2. Target loads calculated using flows measured at USGS gage 07024000 and a target concentration of 360 colonies/100ml.

Table B- 4. Fecal Coliform Measurements in Central Creek

Station	Date	Concentration (colonies/100ml)	Rcode	Rainfall (in/day)	
				Day of sampling	Day before Sampling
Central Creek at Railroad Street	5/24/2000	2000		0.44	0
	6/20/2000	2750		0.15	0.98
	7/24/2000	500		0	0
	8/21/2000	Dry, no sample		0.65	0.64
	9/25/2000	35,600		0	0
	10/23/2000	Dry, no sample		0.43	0
Concentration Representing the 90th Percentile of Samples Exceeding Target of 360 colonies/100ml:			25,745		
Reduction of 90th Percentile Concentration to Target:			98.6%		

Station location: 36.8686(latitude); -89.0100 (longitude)

Table B- 5.Fecal Coliform Measurements in Cooley Creek

Station	Date	Concentration (colonies/100ml)	Rcode	Rainfall (in/day)	
				Day of sampling	Day before Sampling
Cooley Creek at Hickory	5/24/2000	10	<	0.18	0.6
	6/20/2000	157,200		0.01	1.3
	7/24/2000	14,600		0	0
	8/21/2000	1,600		0	0
	9/25/2000	3,000		0.77	1
	10/23/2000	380		0	0
Concentration Representing the 90th Percentile of Samples Exceeding Target of 360 colonies/100ml:			114,420		
Reduction of 90th Percentile Concentration to Target:			99.7%		

Station location: 36.8239(latitude); -88.6426 (longitude)

APPENDIX C DISCHARGE MONITORING REPORTS

Table C- 1. Carlisle County Regional STP (KY0102156) Fecal Coliform DMR Data (2000)

Date	Description Code	Monthly Concentrations (colonies/100ml)	
		Average	Maximum
1/31/00	E90 Numerical Violation	49	>600
2/29/00	E90 Numerical Violation	26	470
3/31/00	E00 Measurement Only, No Violation	10	<10
4/30/00	E00 Measurement Only, No Violation	31	300
5/31/00	E00 Measurement Only, No Violation	17	130
6/30/00	E90 Numerical Violation	48	>600
7/31/00	E00 Measurement Only, No Violation	<23	90
8/31/00	E90 Numerical Violation	<44	>600
9/30/00	E90 Numerical Violation	>558	>600
10/31/00	E90 Numerical Violation	<64	>600
11/30/00	E90 Numerical Violation	>382	>600
12/31/00	E90 Numerical Violation	>56	>600

Data Source: V. Prather, DOW/KPDES Branch, 2005

Table C- 2. Pilgrim's Pride (KY0093874) Fecal Coliform DMR Data (2000)

Date	Description Code	Monthly Concentrations (colonies/100ml)	
		Average	Maximum
1/31/00	E00 Measurement Only, No Violation	24	320
2/29/00	E00 Measurement Only, No Violation	54	400
3/31/00	E90 Numerical Violation	40	1728
4/30/00	E00 Measurement Only, No Violation	10	10
5/31/00	E00 Measurement Only, No Violation	11.2	18
6/30/00	E00 Measurement Only, No Violation	20.7	182
7/31/00	E00 Measurement Only, No Violation	29	350
8/31/00	E90 Numerical Violation	53.5	1182
9/30/00	E00 Measurement Only, No Violation	12	20
10/31/00	E90 Numerical Violation	9.1	520
11/30/00	E00 Measurement Only, No Violation	4.6	20
12/31/00	E00 Measurement Only, No Violation	7	30

Data Source: V. Prather, DOW/KPDES Branch, 2005